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National Ocean Service

Office of Charting and Geodetic Services

Photo by Andy Whipple, San Francisco, California

PENNSYLVANIA STATE UNIVERSITY
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INTRODUCTION

The Office of Charting and Geodetic Services (C&GS) is one of the four principal line offices of the National Ocean Service (NOS). The NOS, in turn, is one of the five major line components of the National Oceanic and Atmospheric Administration (NOAA). Staffed by scientists and engineers, C&GS has developed significant capabilities and contributed many scientific advances over the years in the fields of geodesy, astronomy, hydrography, nautical and aeronautical cartography, photogrammetry, marine engineering, and data management.

The C&GS product line includes nautical, aeronautical, coastal mapping, and geodetic products and technical services to support safe and efficient air and marine transportation, offshore operations and to meet national positioning and elevation control requirements for cartographic applications, engineering projects, land-use planning, and space and defense systems. Making such important contributions to both the governmental and private sectors of the economy, C&GS touches the lives directly and indirectly of nearly all Americans.

NATION'S FIRST SCIENCE AGENCY

C&GS is the oldest scientific organization in the Federal Government, dating from 1807 when President Jefferson recommended to Congress the establishment of a national "survey of the coast." In the ensuing years Congress passed additional legislation to meet scientific and engineering needs of a growing national population and economy thereby placing additional duties and responsibilities on the organization. Although the first geodetic surveys were not begun until 1816, considerable field work had taken place. By 1836 field work had doubled and the name of the organization changed to the U.S. Coast Survey. In 1871, a geodetic connection between the Atlantic and Pacific coasts was officially authorized by Congress and the name changed in 1878 to the U.S. Coast and Geodetic Survey. In 1926, Congress directed the agency to produce aeronautical charts to meet the growing requirements of the new air age. Geodetic measurements provide the baseline from which all aeronautical and nautical charts, coastal, and bathymetric maps are referenced. Hydrographic survey depth measurements and the interpretation of aerial photogrammetric surveys must be based on the national geodetic networks. In this way, all C&GS programs are dependent on one another. The name of the agency

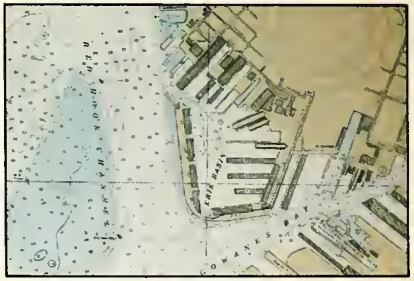
Survey Vessel PATTERSON CIRCA 1885

was changed to the National Ocean Survey when NOAA was formed in 1970, broadening the nautical charting mission to include charts of the Great Lakes, previously administered by the U.S Lake Survey. In December of 1982 the Office of Charting and Geodetic Services within the new National Ocean Service was created to better focus on charting and geodetic services.

First Geodetic Survey in 1816

U. S. Depository Copy

NAUTICAL CHARTING

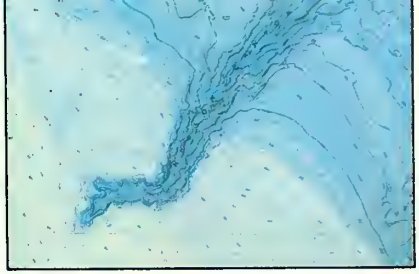


Portion of Chart of New York Harbor

A nautical chart shows coastlines, water depths, reefs, rocks, lights, buoys, landmarks, and other details needed for safe navigation, it is a working tool for the mariner and ship navigator in planning voyages, and determining the safest and most efficient courses. Effective foreign and domestic maritime trade depends on the availability and quality of our nautical charts. And these services are also vital to the success of expanding offshore engineering and resource development projects, and the continued growth in the recreational boating industry.

Congress has charged NOS with the charting responsibility for U.S. oceanic coastal waters and the Great Lakes and connecting waterways, amounting to about 2.5 million square nautical miles; and in meeting this requirement NOS has on issue today about 980 different charts covering this great expanse. Different users require different chart scales and formats. Scales of charts vary from the small scale sufficient for sailing between coastal ports and the open ocean, to the large scales needed to navigate in harbors and restricted channels. Complementing the charts are the nine Coast Pilot volumes which provide supplemental information needed by the mariner on port facilities, harbors, docks, tidal characteristics, piloting, weather

Oblique photo of New York Harbor same area as chart on opposite page



Portion of Bathymetric Map of Hudson Canyon off the east coast

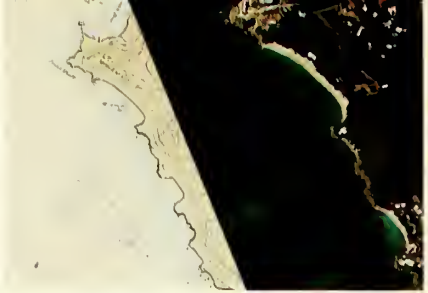
statistics, regulations, and landmarks.

Hydrographic and photogrammetric surveys are carried out to provide the basic data needed to produce C&GS charts and maps. Hydrography is the science that deals with the measurement and description of the bottom features of oceans, lakes, rivers, and adjoining coastal areas. These surveys are carried out by ships of the NOAA fleet from C&GS project instructions. Photogrammetry is the science of obtaining reliable measurements by means of photographs. Aerial photographic methods are employed to position landmarks and aids to navigation for nautical charting and to map the shoreline and adjacent features. Over the years, C&GS photogrammetric mapping capabilities have been applied to other environmental problems dealing with the coastal zone such as boundary determinations, the effects of hurricanes and storms and multiple use problems.

Bathymetric Maps are topographic maps of the sea floor, the size, shape, and distribution of underwater features are portrayed by means of detailed depth contours. These maps are the basic tools for engineering and scientific studies and the management and development of offshore energy and living resources.

Hydrographic Survey/Launch

Photogrammetric Aircraft



Aerial photograph / chart compiled from photograph

HOW TO ORDER C&GS MARINE CHARTING AND MAPPING PRODUCTS

Catalogs which describe these publications and list authorized sales agents throughout the United States are available from the Distribution Branch, N/CG33, Office of Charting and Geodetic Services, National Ocean Service (NOAA), Riverdale, Maryland 20737. Hydrographic survey sheets, digital data, topographic and photogrammetric shoreline maps, and aerial photographs are important by-products which arise out of the data acquisition and processing phases that produce these charts and maps. Information on their availability can be obtained by writing to the Nautical Charting Division, N/CG2, Office of Charting and Geodetic Services, National Ocean Service, (NOAA), Rockville, Maryland 20852.

AERONAUTICAL CHARTING

The C&GS aeronautical charting program consists of the compilation, printing, and distribution of air cartographic materials and other special services which are the basic requirements for all aircraft operations in the United States as stipulated by the Federal Aviation Administration (FAA). C&GS produces approximately 10,000 aeronautical charts annually for air flights in the National Airspace System in the United States, including charts for pilots flying under visual flight rules and under instrument flight rules. C&GS also produces chart-related products for air traffic controllers, airport ground personnel, and the FAA. Aeronautical charts depict navigation data and flight regulation information that are critically important for flight planning, flight navigation, landings and take-offs, and air traffic control. To ensure that these aeronautical charts and chart-related products are accurate and up to date, the C&GS maintains an aeronautical chart data base of over 6 million elements.

Visual Charts provide information to pilots flying under FAA visual flight rules. Since pilots using these charts rely primarily on visual sightings for navigation, visual charts contain a complete topographic base, with an emphasis on prominent natural and man-made features that are critical when a pilot is

Controller with C&GS Video Plate

flying under visual flight rules, such as mountain ranges, major rivers, highways, railroads, cities, and towns. Overprinted on the topographic base of these charts is a multitude of information directly related to aviation, including airport locations, radio aids to navigation, controlled airspace, special use airspace, possible obstructions to flight such as towers and tall buildings, and visual check points.

Instrument Charts provide information to pilots flying under FAA instrument flight rules. Since pilots using these charts rely primarily on flight instruments for navigation, instrument charts do not show topographic features. Instrument charts provide pilots, navigators, FAA management, and air traffic controllers with information on navigational aids, airway bearings and distances, enroute altitudes, and procedures for instrument approaches and departures.

Special Purpose Charts and Related Publications include a variety of controller charts, controller chart supplements, radar video overlays, and digital data and information on possible obstructions to air traffic controllers, and research groups.

Portion of Aeronautical Chart

HOW TO ORDER C&GS AERONAUTICAL CHARTING PRODUCTS

The **Catalog of Aeronautical Charts and Related Publications** contains a brief description of each aeronautical chart and chart-related publication produced by C&GS, the price of the chart, other information needed to select and order aeronautical chart products, and a list of NOAA chart sales facilities and authorized commercial chart sales agents. For a free catalog, write: Distribution Branch, N/CG33 National Ocean Service /NOAA, Riverdale, Maryland 20737.

GEODESY

Geodetic Survey Marks

Construction crew surveying from C&GS monuments

In meeting the geodetic part of its mission, C&GS is responsible for developing and maintaining the National Reference System as defined by the two National Networks of Geodetic Control. Reference points in these networks (horizontal and vertical) are the basic geographic location and elevation starting points for land surveys, cartography, engineering, construction, land information systems, environmental measurements and Earth science. Today these networks consist of approximately 300,000 horizontal and 600,000 vertical points. The spacing and accuracy requirements of these networks involve coordination with other Federal agencies through the Federal Geodetic Control Committee.

GEODETIC DATA AND INFORMATION SERVICES

C&GS carries out field surveys and research and development studies to improve the collection and delivery of geodetic data as well as to increase our understanding of dynamic Earth processes. The data collected from surveys and the results of analyses and research are disseminated to users in a variety of formats. The office also pro-

vides national leadership in geodetic specifications and standards, and assists state and local agencies through a variety of cooperative programs. Each year C&GS responds to approximately 20,000 requests for the following geodetic data and information services:

- Data for horizontal (latitudes and longitude) and vertical (elevations) geodetic control stations with corresponding station description information.
- Geodetic control diagrams covering the conterminous United States, Alaska, and Hawaii.
- Gravity values for over one million points.
- Calibration Base Line Data.
- Astronomic and Doppler satellite data.
- Horizontal and vertical crustal movement data.

The availability of geodetic records and a full listing of publications and prices can be obtained from the National Geodetic Information Center, N/CG17 National Oceanic and Atmospheric Administration, Rockville, Maryland 20852. Information on the availability of software for use in geodetic computations and the possibility of gaining direct access to the geodetic data base can also be obtained from this source.

THE FUTURE OF CHARTING AND GEODETIC SERVICES

During the past few years, major emphasis has been placed on the conversion of aeronautical and nautical operations from manual to computer-assisted automated systems. Hydrographic data acquisition and processing have also been made more productive by the use of improved echo sounding equipment and the automated logging and plotting of survey data. The introduction of Bathymetric Swath Survey systems and the use of side scan sonar has given C&GS the capability of performing more complete hydrographic survey coverage in more areas. The C&GS now employs an automated analytical plotter which greatly facilitates photogrammetric analysis of aerial photographs. A computer-assisted automated distribution system for aeronautical and nautical charts has been installed.

Over the past few years, a major effort has been devoted to the adjustment of the National Networks of the Geodetic Control. The network adjustments will result in new datums — the North American Datum of 1983, and the North American Vertical Datum of 1988 — which will improve the accuracy of the entire horizontal and vertical networks.

Conventional geodetic surveying techniques are being replaced by new systems which have been adapted from satellite and space

Automated Cartography

Very Long Baseline Interferometry
Receiving Antenna

technologies such as the Global Positioning System (GPS) and Very Long Baseline Interferometric (VLBI) survey technique. In the future, this office will convert its field operations to these new systems. Polar motion measurements have undergone a complete technological change with the recent installation of a three-station VLBI receiving array of radio telescopes in the United States. Radio signals received from extragalactic sources (quasars) are observed to monitor Earth rotation and polar motion. These observations provide a primary frame of reference from which all geodetic measurements and positions are compared and also information which is essential in crustal motion monitoring and analyses. Crustal motion data are required for the siting of nuclear power plants, for determining areas of submergence or earthquake hazards, and for other sensitive situations. GPS is a satellite system which will allow C&GS to achieve 2- to 3- centimeter accuracy for determining the coordinates of any point on the Earth.

The C&GS stands on the threshold of a new era in user products providing greater accuracy and improved delivery systems in supporting the nation's economic growth.

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National Oceanic and Atmospheric Administration
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